August 1950 ET-289

United States Department of Agriculture
Agricultural Research Administration
Bureau of Entomology and Plant Quarantine

A PORTABLE FIELD CAGE 1/

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Several common disadvantages of portable field cages have been overcome by using plastic screen for the covering and standard electrical conduit for the framework. The utilization of these materials has made it possible to construct a cage that is (1) light, (2) portable intact, (3) easily assembled and taken apart, and (4) conveniently stored. In addition, meteorological factors are not seriously modified.

The cage described in this paper was designed to confine or exclude bees in pollination experiments (fig. 1). The dimensions were chosen to fit immediate requirements. Other sizes might be more practical. The cages have held up well through two seasons of use, largely because of sturdiness supplied by rigid corner construction. However, the top screen in some of the coverings used from spring to fall has become brittle. The life of these covers depends upon careful handling so as to avoid creasing.

The cage covers an area of 247 square feet -- 11½ feet wide, 21½ feet long, and 6 feet high. A plastic screen covering (12 by 12 mesh) is supported on a framework of ½-inch electrical conduit, which is anchored to the ground with steel stakes and wire. A 6-foot zipper is installed in each of the four corners to permit entrance, and to facilitate the handling and folding of the cover for storage.

1/ Cooperative legume seed investigations conducted at Logan, Utah, by the Bureau of Plant Industry, Soils, and Agricultural Engineering, the Bureau of Entomology and Plant Quarantine, and Utah Agricultural Experiment Station. Photographs were taken by W. P. Nye. Clarence Austin aided materially in the cage construction.

2/ Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering.

3/ Division of Bee Culture Investigations of this Bureau.

4/ Division of Cereal and Forage Investigations of this Bureau.

The weight of the assembled cage is approximately 115 pounds, the cover weighing 32 pounds and the framework 83 pounds. Two men can easily pick it up and move it for short distances.

Comparative tests were made of the relative humidity, temperature, light, and wind movement inside and outside these cages. The results, shown in table 1, indicate no significant differences in temperature and humidity but a significant reduction in light and in wind movement. No differences in alfalfa growth have been observed that could be attributed to a cage effect.

Table 1. Comparison of meteorological conditions inside and outside of 12- by 12-mesh plastic screen cages covering alfalfa.

Location of reading	Relative humidity 1/	Temperature 1/	Light 2/	Wind 3/
	Percent	°F.	Candles per square foot	M.p.h.
In cage	43.3	70.5	158	5.27
In open	39.7	70.3	193	6.70
Difference	3.6	0.2	-35 4/	-1.43 5/

1/ Average of 1 reading in each of 6 pairs of plots taken with a psychrometer.

2/ Average of 2 readings in each of 8 pairs of plots taken with a photographic meter.

3/ Average of 20 readings in each plot of 1 pair taken with an anemometer.

4/ Highly significant (1% level).

5/ Significant (5% level).

Construction of Conduit Framework

The boxlike framework is made from suitable lengths of conduit coupled to welded corner units. Short lengths are cut from standard 10-foot pieces with a hacksaw. Two or more pieces must be coupled to form lengths longer than 10 feet. A conduit bending tool is essential for making bends.

Corner units (fig. 2):

The corner pieces are 4-foot lengths of conduit bent at right angles. One of these corner pieces is welded to each end of the corner posts. The 2½-foot braces, which support the corner pieces, are then welded into place as shown. A wooden form made to hold the pieces of conduit in place while starting the welds speeds up the operation and assures uniform corner units. Ends of the braces can be more easily welded if depressed on one side with a ballpeen hammer.

Sides and ends:

The upper and lower end pieces are 7½ feet long. The upper and lower side pieces are 17½ feet long (a 10-foot length coupled to a 7½-foot length).

Cross members (fig. 5):

Three cross members are used in the top of the framework to prevent the covering from sagging. The center one is a regular 10-foot length attached to 6-foot posts by means of side supports. The other two are made by coupling together a 10-foot piece and a 1½-foot piece. A small hole is drilled in each end of the 11½-foot cross members for use in wiring them to the main part of the frame.

Side supports (fig. 3):

The connector piece for the center cross member is made by bending a 1½-foot length at a right angle. The piece is then welded to the 6-foot post so that the bottom of the horizontal arm is level with the top of the post. A small hole is drilled through the post ½ inch from each end and in the same plane as the connector piece.

Construction of Screen Covering

The covering is made as follows:

1. Cut the strips of plastic screen from the rolls.

2. Sew the strips together in the design indicated (fig. 4a), using ½-inch cloth tape to strengthen the seams. Use double stitching. Cotton thread is satisfactory.

3. Install the zippers. The edges of the screen (c) are folded back for 1 inch and bound between the zipper and 1-inch cloth tape, using a double seam.

4. Bind the remaining edges (b). Sew 2-inch webbing along the four sides, folding unfinished edges back. A double thickness of canvas can be substituted for webbing.

5. Install the grommets at 18-inch intervals along the webbing.

Assembly and Anchorage

Although one person can assemble the framework (figs. 5 and 6) and put the covering in place, it is much more convenient for two people to do it together. After both ends are assembled on the ground, they are raised to their upright positions and joined with the side pieces. The center cross member is next coupled directly to the connector piece of the side supports. This U-shaped unit is then wired in place, being fastened to the upper and lower side pieces. Care should be exercised to twist the wire in such a way that it cannot catch in the covering. An auxiliary cross member is then wired in place halfway between the center cross member and each end of the cage.

After the covering is pulled over the framework the zippers are closed. The covering is then securely fastened to the bottom of the framework by wiring each grommet to the conduit. For some purposes more positive closure may be necessary, in which case the bottom can be banked with soil. Canvas that is to be kept covered for extended periods of time with moist soil should be treated to make it rot resistant.

Anchorage is the final step. The bottom of the cage is secured to the ground with open-end steel stakes (fig. 3). These stakes are driven into the ground until the hook comes into place over the conduit. Guy wires from the corner units and side supports are attached to closed-end stakes in the ground (fig. 3). Guy wires can be placed either inside or outside the cage and have been used both ways satisfactorily. Convenience and local wind conditions should govern the arrangement. The outside anchorage is preferable against strong winds, since holes may form where the wires go through.

Storage

Two men can dismantle and store a cage in 30 minutes. The flexible covering may be folded or rolled into a compact bundle. The four corner units partially nest.

Materials and Cost of Cage

Item	Units	Length (feet)	Estimated cost, wholesale
Framework			
Couplings	24		$ 3.00
Conduit (½-inch galvanized)			17.00
Corner units			
Corner posts	4	6	
Corner pieces	8	4	
Corner braces	16	2½	
End pieces	4	7½	
Side pieces			
Long length	4	10	
Short length	4	7½	
Side supports			
Posts	2	6	
Connector pieces	2	1½	
Cross members			
Center	1	10	
Auxiliary			
Long pieces	2	10	
Short pieces	2	1½	
Covering			
Plastic screen (3-foot width)			30.00
Strips	4	34	
Strips	4	22	
Zippers (6 feet)	4		4.00
Anchorage			
Stakes (3/8-inch iron)			1.00
Closed end	6	1 1/5	
Open end	6	1 1/5	
Baling wire		75	
Labor			
Sewing (including webbing, grommets, tape, and thread)			20.00
Welding			4.00
Cutting and bending			1.00
		Total	$80.00

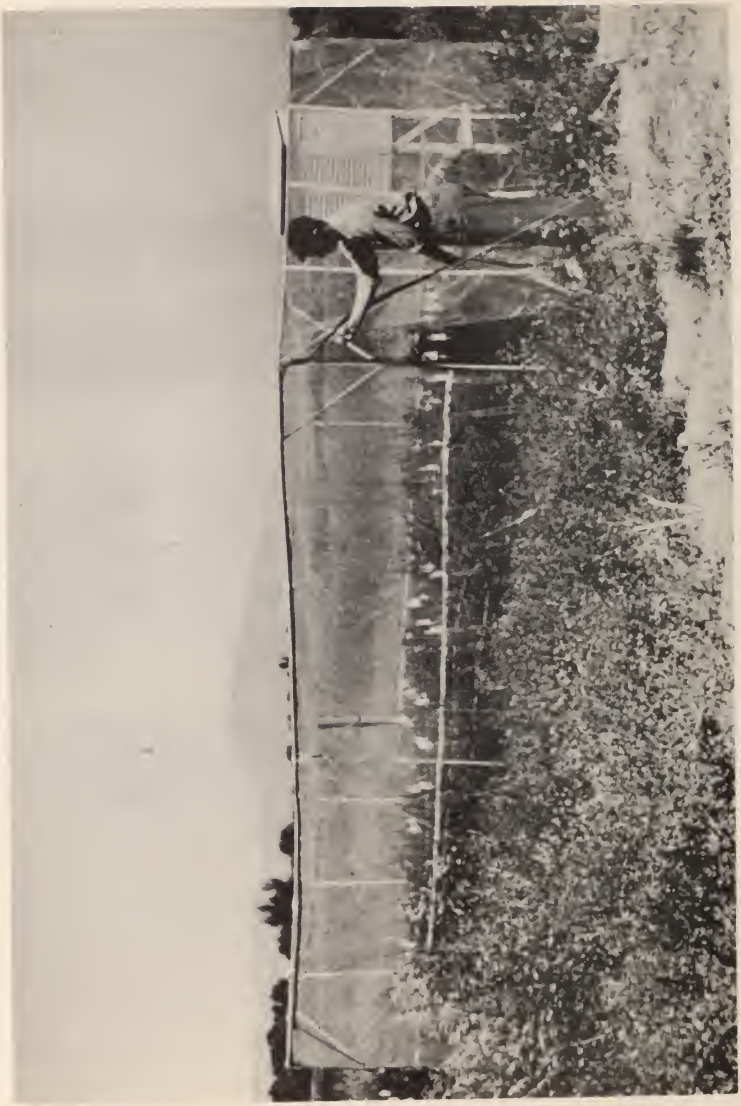

Figure 1.--A field cage in use.

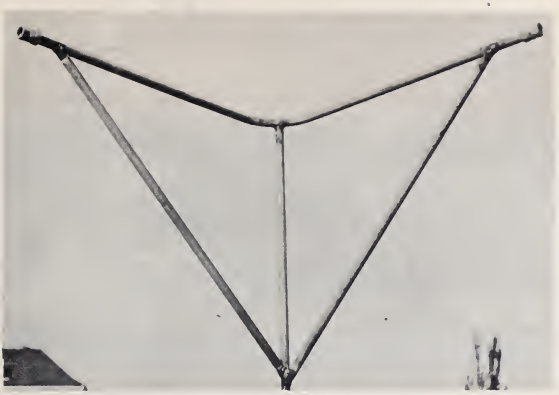

Figure 2. --View of upper half of a corner unit.

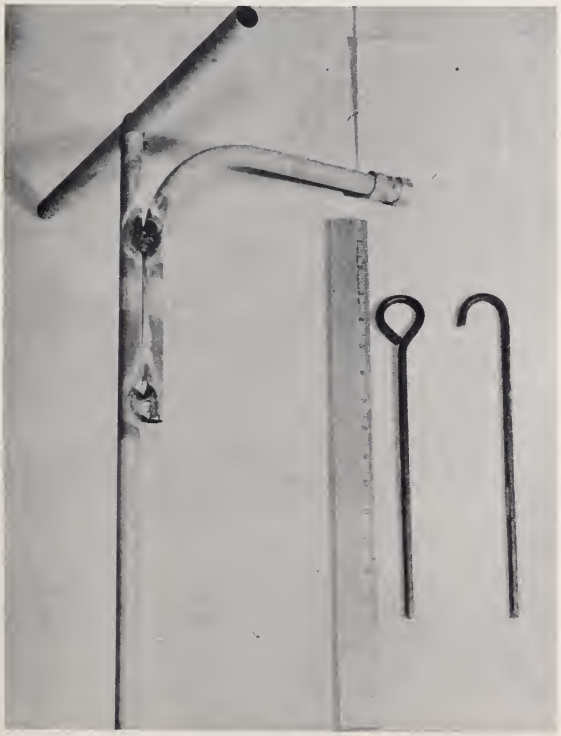

Figure 3. --Side support showing welded, wired, and coupled connections. The two types of anchorage stakes are shown at the right.

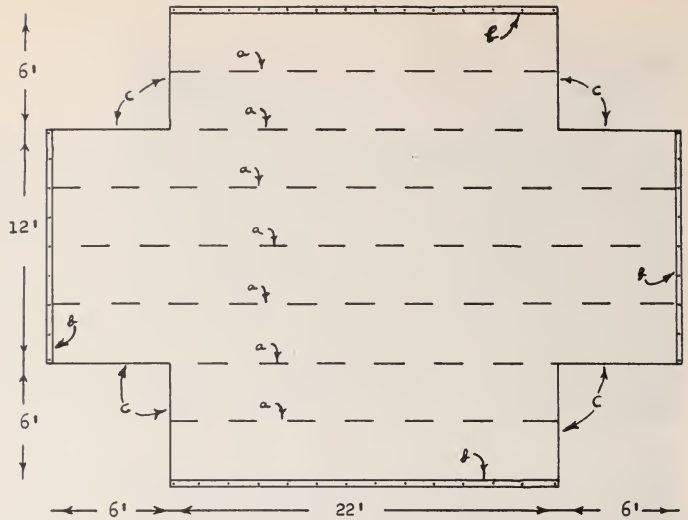

Figure 4. --Diagram showing shape and seams of cage covering: a, Double seams with 1/2-inch cloth tape; b, 2-inch webbing or canvas with 3/8-inch grommets at 18-foot intervals; c, zipper sewed on 1-inch tape with double seams.

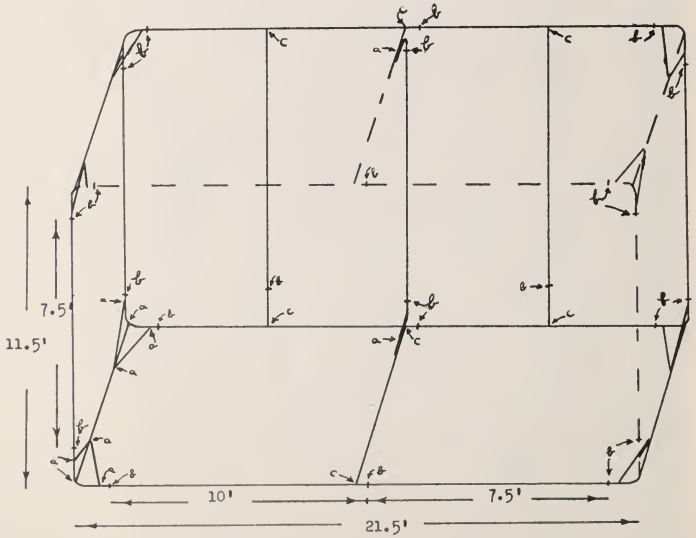

Figure 5. --Diagram of 1/2-inch conduit framework for supporting cage: a, welded joint; b, watertight coupling; and c, wired joint.

Figure 6. --Experimental set-up with frameworks assembled.